Geophysical Research Abstracts
Vol. 15, EGU2013-5361, 2013
EGU General Assembly 2013
© Author(s) 2013. CC Attribution 3.0 License.

Assessment of the capabilities of the tICA and stICA methods for geophysical signal separation in GRACE data

Eva Börgens (1), Elena Rangelova (2), Michael Sideris (2), and Jürgen Kusche (1)

(1) Bonn University, Astronomical, Physical and Mathematical Geodesy, Bonn, Germany, (2) Schulich School of Engeneering, University of Calgary, Canada

We investigate the potential of the tICA and stICA methods for separating geophysical signals in GRACE gravity data. Since the start of the Gravity Recovery and Climate Experiment (GRACE) satellite mission in 2002, GRACE has provided us with global gravity data with a spatial resolution of a few hundred kilometers and a temporal resolution of one month, 10 days or even a week. These data represent the total, integrated gravity change inducing by mass signals related to hydrological processes, post glacial rebound (PGR), ice mass change and others. Isolating a particular mass signal may be accomplished by removing all others using geophysical background models, but these are usually not perfect. Therefore methods are required for separating data into the different geophysical signals on the basis of their statistical properties. To this end, we assess the potential of temporal Independent Component Analysis (tICA) and spatio-temporal Independent Component Analysis (stICA). The tICA method is based on the assumption of statistical independence of signals in the temporal domain and thus separates the GRACE-observed mass changes into maximal independent source signals. In comparison, stICA maximizes both the temporal and spatial independence. These two ICA methods are compared to the conventional Principle Component Analysis (PCA). We test them on GRACE data with respect to their ability to separate the hydrology signal from a trend signal not induced by hydrological processes, such as post glacial rebound (PGR). In addition, we investigate whether they are capable of separating the hydrological signal in annual and semi-annual components.

We analyze both simulated and CSR GRACE water mass anomalies (January 2003 -December 2010). The simulated mass anomalies are composed of outputs of hydrologic, PGR, ice loss and ocean bottom pressure models. The two ICA methods are capable of separating the trend and annual hydrology signals both on a global and regional scale (North America). In the global case, the separated trend contains the PGR and the ice mass loss in Greenland, Alaska and Antarctica. In comparison, PCA is not able to separate fully the trend from the annual hydrology signal.

Furthermore, we test the methods in four major river basins in Africa: Nile, Niger, Congo and Zambezi. In the simulation scenario, the two ICA methods are not superior to PCA in separating the annual and semi-annual hydrology variability. However, when using the real GRACE data, we again demonstrate that the ICA methods are better in separating long-term variations compared to PCA.